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# Tilt of planets

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**Abstract** . Most planets have their axis of rotation tilted with respect to the normal to the plane of the orbit The planetary magnetic field is also tilted and is also inclined with respect to the axis of rotation So far, there has been no satisfactory explanation Chaotic stability is like accepting the tilts as they happen to be there Giant impacts have been fully ruled out. The author proposed in 1989 that there have been nuclear explosions in planets In this paper, the tilt of the earth and the tilt of its magnetic field are taken up on the basis of the kick received by the planet when there was an explosive emission of a satellite

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The earth when formed about 5 billion years ago, was a hot sphere rotating about its axis which was not tilted and the earth had no magnetic field. Now the axis of rotation is tilted by 23.4° and the direction of the magnetic field makes an angle 11.9° with the normal. Whatever be the origin of earth's magnetic field, either through convection currents inside the core or through spontaneous magnetization of some ferromagnetic atoms *e.g.* $^3$He, the direction will be along the axis of rotation. For the earth, this implies that when the field was created, the earth's axis was already tilted to 11.9°. In our view [1], the field was created by the magnetism of $^3$He produced as a result of the giant nuclear explosion which also resulted in the explosive emission of the moon and the tilting of the earth through 11.9°. There was later a second explosion that got the earth tilted further by 11.5° to give the present tilt of 23.4°. The second explosion must have resulted in the emission of large amount of mass from the earth, which returned to the earth as dust since the material could not escape the Roche limit. There are so many instances of missing satellites and formation of rings and haloes around some planets because of the crumbling of the satellites. The evidence of such a second explosion inside the earth is available [2] in the believed large increase of magnetic field about two billion years ago. There is also the often hypothesized obstruction of sunlight for a longish period that upset the progress of evolution of life on the surface of the earth.

In order to evaluate the kick received by the earth at the time of the explosive emission of the moon, let the emitted mass be $m$. The speed on explosion must be more than 11 km/sec. It is likely to be much more and the calculated value of tilt for the bare escape velocity will be the lower limit. The angular momentum lost will be $A$ (let) $= m \times 11 \times R$, where $R$ is the radius of the earth at the time of the explosion. The angular momentum of the earth resulting from the received kick will be the same in magnitude. This also provides the tilting couple. When the inertial rotation couple $Iw'$ is compounded with the tilting couple, the resulting couple $Q$ is at an angle $\phi$, the angle of the tilt, where

$Q \cos \phi = I\ w'$, $w'$ being the angular velocity of the earth and $I$ its moment of inertia,

and $Q \sin \phi = A$.

Thus, the resultant couple is given by $Q = (I w') + A$ which also means that the speed of rotation will increase, but this increase is negligible. The angle of tilt is given by

$$\phi = \tan \phi = A / I w'$$

If the tilt is to be 11.9, we must have

$11.9 = m \times 11 \times R /$ mass of the earth $\times 0.3306 \times R^2 \times w' \times 180/\pi$. Using mass of the earth to be $81 f$ times that of the expelled mass where $1/f$ is the fraction of the present mass of the moon that got expelled, we get $w'$ to be about 16f times as fast as compared to the present speed of rotation.

From the energy considerations, the expected fraction is ¼ and from continuous slowing down of the earth's rotation, the angular speed could only be about 4 times. The discrepancy must be resolved by the ejection to have occurred tangentially at a speed much higher than the escape velocity, on account of high centrifugal speed of the detached mass.

The second explosion could not give rise to a second satellite since unlike the emergence of the moon, it could not escape beyond the Roche limit for the earth perhaps because of the relatively less intensity of the second explosion and fell back as dust. Similar atomic explosions in other planets led to their tilts as well as emergence of satellites, rings or haloes. The inputs of surplus energy of the atomic explosions must have been responsible for crustal and orogenic upheavals and emergence of water of hydration from inside the earth. The calculation above has to be based on estimates of conditions billions of years ago and may not be exact. A preliminary treatment of the whole subject but for the details of the earth's tilt has been attempted in [3].

As stated earlier, an attempt has been made in [4] to ascribe the tilt of planets as a consequence of chaotic revolution of the planet when any random tilt (within certain very wide limits) can be stable for an uncertain period. This kind of theory is quite unproductive and practically of the genre of creation mythology. It is true that the parameters in our calculation are based on estimates and cannot be exactly determined, but the theory ties many subjects together, like emergence of satellites and initial direction of the magnetic field as well as it accounts for the tilt in case of every planet.

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